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Bleeding and Gutting of Cod

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Grimur Valdimarsson, Asgeir Matthiasson and Gunnar Stefansson:

BLEEDING AND GUTTING OF COD

1. Introduction

Proper bleeding of the fish carcass has a decisive effect on product quality, whether the fish be fresh, frozen or salted.

Poor bleeding makes the fish flesh dark or reddish, thus relegating it to a lower quality grade. It is well known that live bleeding of the fish into running water is most important. However, opinions differ as to what to avoid when bleeding fish. The Icelandic fresh fish regulations of 1970 warn against severing the frontal artery located between the heart and the gills. The reason is to prevent damage to the heart since the heart-beat aids the removal of blood from the vascular system of the fish. On the other hand several studies have shown that better results are obtained by deep incisions, i.e. severing of both the abdominal and dorsal arteries (Huss & Asenjo, 1976). It seems that this method has in fact been practiced in Iceland for many years.

The cited study by Huss & Asenjo actually found no difference in fillet quality whether the heart had been removed or not. The authors maintain that it is muscle contractions, or death throes, which most affect the drainage of blood from the muscle tissue of fish. The Icelandic fresh fish regulations also stipulate that an abdominal incision must be made and the fish gutted before the blood is drained off. This directive aims to ensure that bleeding and gutting are carried out as two separate procedures. By contrast it is common abroad to bleed the fish, make the incision and remove the viscera in a single procedure. The latter method is considerably less time-consuming and has therefore been adopted increasingly by Icelandic fishermen in recent years.

This matter has led to conflict between fishermen and fish processors, the latter maintaining that fish bled and gutted in a single procedure yields a lower quality of raw material than fish treated by the two-step method. Salted fish has been mentioned especially in this connection; more blood vessels appear in the wing of the cut-up fish, making the flesh dark.

To throw light on this dispute the Fisheries Ministry decided to study these different methods of bleeding and gutting to determine their effect on the quality of fresh, frozen and salted fish. The experiments were planned in collaboration with the fishermen's association, the fish industry sales association and the Fish Products Inspectorate.

2. Methods

Two experiments were conducted, both on board the trawler Asthor RE 10, the first at Halamidur in November 1983 and the second at Vikurgrunn in April 1984.

Live, undamaged and small-bellied cod, 50-80 cm in length, were brought up from the same locations three days in succession. Each day 80 fish were selected with a total of 464 fish utilized in the two experiments. The study design is shown in Figure 1. All fish were bled by deep incisions, severing both the abdominal and dorsal arteries. Half the fish were allowed to remain on the deck for four hours (dead) before bleeding and evisceration, by which time rigor mortis had set in. The other half were dealt with immediately (live). Each group was then divided in two. Half were bled by severing the jugulars and letting the fish bleed for 15 minutes before making a frontal incision and removing the viscera (two procedures). The other half were dealt with the same way, except that the frontal incision was made and the fish gutted immediately after severing the

jugulars (one-step method). Every other fish was bled in running water and every other on deck (in the open air). After washing in a mechanical fish washer for about one minute, all fish were immersed in ice, abdomen down, in 90 litre plastic containers. Following four days' storage in ice, the fish were filleted by hand, each fillet being marked with numbered plastic markers. Following the fresh fish appraisal, the right fillet of each fish was quick-frozen (including skin and bones) while the left fillet was processed into fresh salted fish.

2.1 Grading

Each fillet was graded by three independent appraisers. Employees of the Fish Products Inspectorate carried out the fresh fish appraisals, while salted fish was graded by appraisers from S.I.F., and frozen fish by inspectors from the fish products departments of S.I.S. and S.H.

Fresh fish was graded according to the fresh fish grading regulations (1970) while grading of salted fish followed the salted fish grading regulations (1973). Under these regulations fish is classified in four grades, grade 1 being premium quality, and grade 4 being rejected as unfit for human consumption. The colour of salted fish and cut surfaces was classified as follows: Category 1: Colour light and normal; Category 3: Colour distinctly dark: Category 2: Colour intermediate. Grading of frozen fish was carried out on defrosted fillets after removal of the wing. Fillets and wings were graded separately. The grading scale of the frozen food sales association was used (Valdimarsson 1981) which classifies premium product as Grade 5 and rejected material as Grade 1. Wings were graded by the same system.

2.2 Selection procedure

Grading results were processed in two ways. Firstly the mean grade was calculated for each category, and secondly the percentage of wings of "premium quality". For a wing to be assigned a certain grade, at least two appraisers had to concur on the result.

Fresh and salted fillets assigned to Grade 1 were considered premium quality. For frozen fillets and wings, the premium quality category was Grades 4 and 5. The mean grade only has been used in arithmetic calculations.

The two experiments were designed arithmetically, individually and together. Statistical analysis was carried out in order to determine the effect of the different treatments on grading results. For this purpose the so-called P value was calculated, being the criterion to determine the significance of differences found between treatment categories. A more precise explanation of the arithmetic calculations and results is provided in the English edition of this paper (Valdimarsson et al. 1984).

3. Results

Very few fish showed signs of damage other than that resulting from the various bleeding and gutting procedures. Such damage, e.g. tissue damage and wounds caused by the procedures, has not been taken into account in the final assessment.

While there is some variance in results, both experiments point in the same direction. The results of both experiments are therefore discussed together. Table 1 shows the mean grade achieved in each category, while figures 2-5 show the distribution of premium grade product. From figures 2-5 we can see that the most pronounced quality

deterioration was caused by bleeding the fish after death, as was expected. In this respect the most significant effect was seen on frozen fish, as shown in figure 3, where less than 20% of frozen fillets from fish bled after death reached the premium quality grade. As indicated by the P values in Table 2, significant differences were found in every category between fish bled live and dead.

Bleeding the fish in running water considerably improved overall product quality, especially where the fish had been bled live. The effect of water treatment was significant in all categories, except fillets (see Table 2). This observation stems from the finding that water treatment of fish bled after death made no difference to fillet quality, as shown in figure 4.

The different methods of bleeding and gutting, i.e. whether bleeding and evisceration was carried out as one of two procedures, divided the results into two categories. The greatest difference was seen between fish bled in running water and fish bled on deck (in the open air). As seen in figures 2-5, there was minimal quality difference between the two methods if the fish had been bled in running water. If, on the other hand, the fish had been bled in the open air, bleeding and gutting in one or two procedures made a considerable difference in the fresh fish category (figure 2). It was therefore necessary to differentiate the P value on the basis of water treatment to determine whether the choice of bleeding and gutting method had a significant effect. Table 2 shows that when the fish is bled in running water there is no significant effect on product quality, except in the colour of salted fish. It should be noted, however, that when the two experiments were analyzed separately, significant differences were found in the second experiment in respect of fresh fish. The fresh fish quality deteriorated significantly if the fish had been bled and gutted in a single procedure, and had been bled in the open air. No such difference was found in the quality of frozen fillets or salted

fish, although overall colour, as well as colour at the gutting incision, was less satisfactory where bleeding and evisceration had been carried out in a single procedure.

Conclusions

1. Optimum product quality is obtained when the fish is bled live and in running water.

2. If the fish is allowed to bleed in running water for at least 15 minutes, there is little difference whether the bleeding and gutting is carried out in one or two procedures.

3. If the fish is bled in the open air, bleeding and gutting should be carried out as two separate procedures.

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Table 1. Mean quality grade achieved in appraisals of cod bled and gutted by different procedures.

			Mean grade						
			Fresh	Frozen		Salted			
Condition of fish	Bled in	Bled and gutted in one or two procedures	Fresh fish grading[1]	Fillets with wings removed[2]	Wings[2]	Salted fish grading[1]	Overall colour category[3]	Colour of gutting incision	No. of fish
Live	Water	Two	1.2	3.81	3.56	1.19	1.05	1.10	61
		One	1.17	3.85	3.28	1.13	1.08	1.19	61
	Air	Two	1.33	3.65	2.98	1.38	1.24	1.39	60
		One	1.56	3.84	2.94	1.40	1.25	1.64	44
Dead	Water	Two	1.47	3.07	2.40	1.62	1.36	1.47	60
		One	1.53	2.81	2.07	1.58	1.55	1.47	59
	Air	Two	1.63	3.12	2.60	1.62	1.51	1.68	60
		One	1.76	3.04	2.10	1.74	1.75	1.82	59
									464

[1] Grading scale: 1, 2, 3 and 4.
[2] Grading: 5 best, 1 worst.
[3] Grading: 1 best, 3 worst.

Table 2. Arithmetic analysis of the quality grade differential resulting from bleeding and gutting of cod by different methods.

	Fresh	Frozen		Salted		
Treatment	Fresh fish grading[1]	Fillets with wings removed[2]	Wings[2]	Salted fish grading[1]	Overall colour category[3]	Colour of gutting incision
Live compared to dead[1]	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001NS
Bled in water compared to bled in air[1]	0.0001	0.0053	0.0348NS	0.0013	0.0001	0.0001NS
Bled and gutted in one procedure compared to two procedures[2].						
(a) Bled in water	0.1614NS	0.0750NS	0.0338NS	0.4818NS	0.0053	0.3422NS
(b) Bled in air	0.006	0.4907NS	0.0008	0.3401NS	0.0205	0.0006

NS: Differential not significant at safety limit of 10%

1) P $\frac{0.10}{18}$ = 0.0056 2) P $\frac{0.10}{12}$ = 0.0083

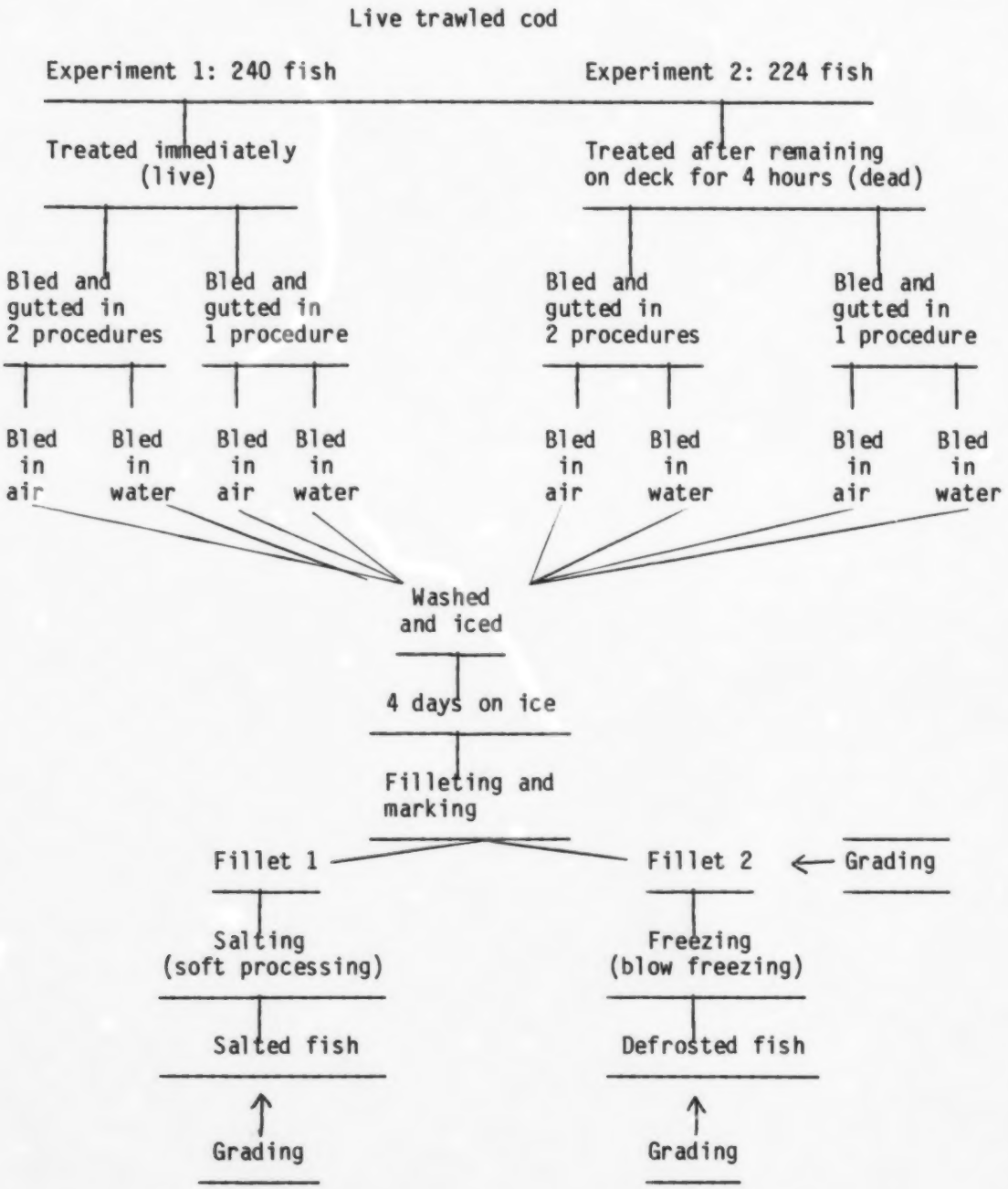

Figure 1. Design of study on bleeding and gutting of cod.

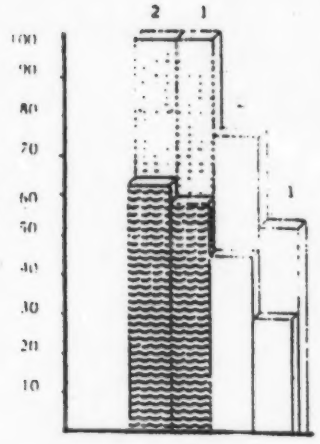

Figure 2: Fresh fillets

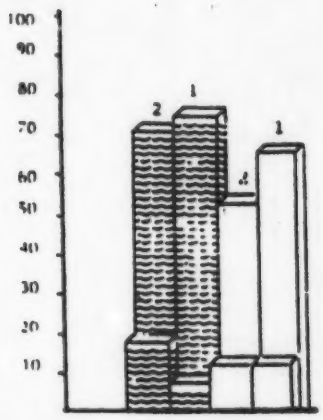

Figure 3: Frozen fillets with wings removed

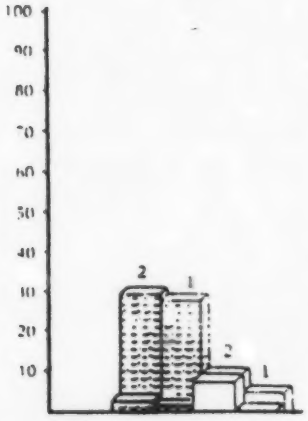

Figure 4: Frozen wings

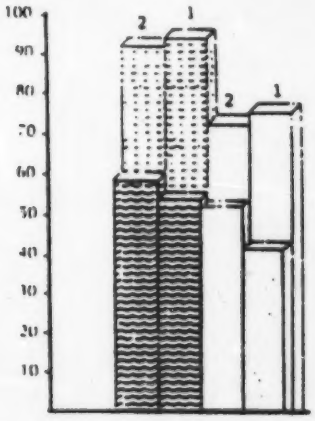

Figure 5: Salted fish

Live fish bled in running water

Live fish bled in open air

Dead fish bled in running water

Dead fish bled in open air

Figures 2-5. The effect of various bleeding and gutting procedures on the quality of cod produts.